DOCUMENT RESUME

ED 455 111 SE 065 063

AUTHOR	Weeks, Denise Jarrett, Ed.; Stepanek, Jennifer, Ed.
TITLE	In an Era of Reform: Standards and the Classroom.
INSTITUTION	Northwest Eisenhower Regional Consortium for Mathematics and Science, Portland, OR.
PUB DATE	2001-04-00
NOTE	21p.; Published three times per year.
CONTRACT	R319A000007
AVAILABLE FROM	Northwest Eisenhower Regional Consortium at the Northwest Regional Educational Laboratory's Mathematics and Science Center, 101 SW Main Street, Suite 500, Portland, OR 97204. Tel: 503-275-9500; Web site: http://www.nwrel.org/msec/.
PUB TYPE	Collected Works - General (020) -- Collected Works - Serials (022)
JOURNAL CIT	Northwest Teacher; v2 n1 Wir. 2001
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Academic Standards; Elementary Secondary Education; *Mathematics Education; Professional Development; *Science Education

ABSTRACT

This Northwest Teacher is a journal that is devoted to rigorous and imaginative learning. In the Winter 2001 issue, articles include: (1) "Standards and the Impulse for Human Betterment" (Denise Jarrett Weeks); (2) "Teachers Taking Charge of Change" (Suzie Boss); (3) "Using the Standards To Illuminate Big Ideas in Science" (Jennifer Stepanek); (4) "Connected Corner: Technology Tips" (Amy Pearl); (5) "Classroom Resources: Books and Materials Available from the Lending Resource Collection" (Amy Sutton); and (6) "Discourse: Listening to One's 'Inner Voice of Authority'" (Sheila Koyama). (ASK)

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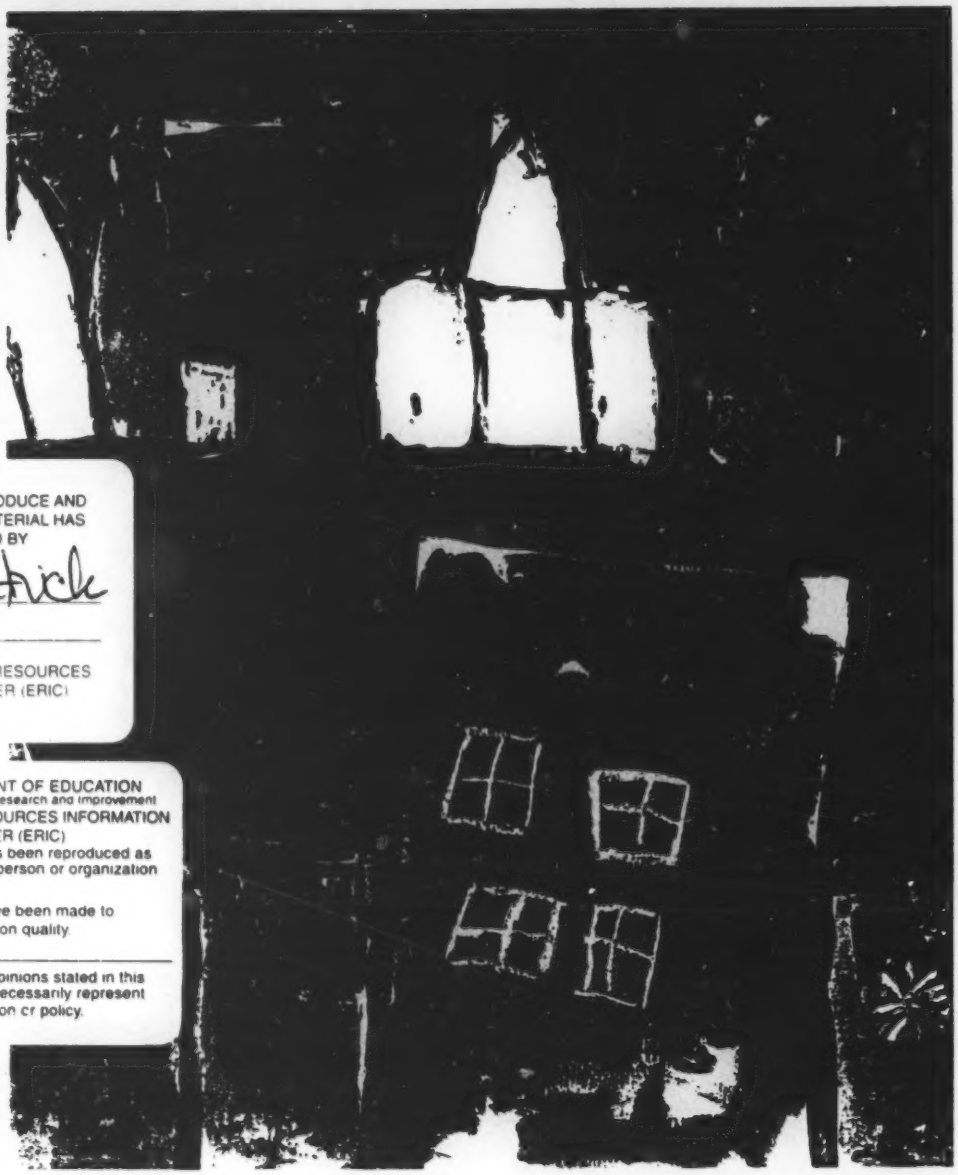
NW northwest

TEACHER

VOLUME 2 NUMBER 1 WINTER 2001

A PUBLICATION OF THE NORTHWEST EISENHOWER REGIONAL CONSORTIUM FOR MATHEMATICS AND SCIENCE

A MATH AND SCIENCE JOURNAL DEVOTED TO RIGOROUS AND IMAGINATIVE LEARNING



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IN AN ERA OF REFORM: STANDARDS AND THE CLASSROOM

▪ Impulse for Human Betterment ▪ Taking Charge of Change ▪ Illuminating Big Ideas in Science ▪ Technology and Resources

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ON THE COVER:

This cityscape is by Laurer Satchwell, 6, a student at Innerscape Art Center in Portland, Oregon.

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NORTHWEST TEACHER IS A PUBLICATION OF THE NORTHWEST EISENHOWER REGIONAL CONSORTIUM FOR MATHEMATICS AND SCIENCE AT THE NWREL MATHEMATICS AND SCIENCE EDUCATION CENTER.

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NORTHWEST TEACHER is published three times a year by the Northwest Eisenhower Regional Consortium for Mathematics and Science at the Northwest Regional Educational Laboratory's Mathematics and Science Education Center, 101 SW Main Street, Suite 500, Portland, Oregon 97204, (503) 275-9500. Single copies of the publication are available free of charge while supplies last to educators within the Consortium's region of Alaska, Idaho, Montana, Oregon, and Washington. To request a free copy, contact the Consortium by e-mail at math_and_science@nwrel.org, by telephone at (503) 275-0457, or place an order from the Web site at www.nwrel.org/msec/. An online version of the publication is also available for downloading from this Web site. Multiple copies, and copies to individuals outside the Consortium's region, may be purchased through NWREL's Document Reproduction Service at the above address, or direct orders by e-mail to products@nwrel.org; by fax, (503) 275-0458; or by telephone, (503) 275-9519.

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THE GIVE-AND-TAKE OF conversation can be a powerful professional development tool. When teachers talk to each other about their practice, they learn by sharing their experiences and beliefs, asking questions about their work, and building on each others' methods and ideas.

EDITORS' NOTE

DENISE JARRETT WEEKS
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We launched *Northwest Teacher* last year as a forum for sharing stories, taking a look at timely issues and best practices from real-life classrooms. We are pleased to announce that this free journal will be published as a project of NWREL's Mathematics and Science Education Center's new undertaking, the Northwest Eisenhower Regional Consortium for Mathematics and Science. (Read more about this exciting development in A Word from the Director on Page 17.)

New ideas can provide a spark of energy and help to start or expand conversations among school staff members. We hope that the journal will serve as a starting point for dialogue and inquiry. *Northwest Teacher* is published three times a year, and each edition focuses on a key topic in mathematics and science instruction. Some of the themes on the horizon include lesson study and taking science inquiry outdoors. To sign up for a free subscription, see the facing page for ordering information.

This issue takes a look at the progress of mathematics and science standards in schools. At the policy level, all Northwest states have standards in place, and most teachers are aware of them. It seems appropriate now to look at the smaller picture—how standards are fitting into classroom practice.

Courtesy Innerscape Art Center

In this issue you will find a range of perspectives on standards. The overview looks at the state of the standards today, highlighting the issues and challenges that teachers are grappling with in their quest to put standards into practice. We take you to the classroom of biology teacher Marlo Blewett, who shares her strategies for using science standards and the impact they have on her teaching. We also visit Edmonds, Washington, and a cadre of teachers who have taken the lead in their district's standards reform, helping to shape and define how standards-based mathematics will look in classrooms throughout their district.

Standards provide ideas about teaching and learning, rather than simply prescriptions to be followed. To bring standards into the daily reality of teaching, educators are thinking about how standards relate to their own ideas about the purpose of education, weighing the standards against their own knowledge and experience, and trying to figure out what kind of changes they want and need to make in their classrooms. By talking with each other, teachers can share the puzzle of deconstructing and personalizing mathematics and science standards.

In the spirit of conversation, we urge you to write to us with your ideas and tips on where good things are happening in Northwest schools, to offer feedback on the journal, and to submit letters for the Discourse column.

Our vision is that *Northwest Teacher* will serve as a tool for professional development by actively engaging readers and by speaking to them as imaginative problem solvers, thoughtful inquirers, and lifelong learners. The stories that follow were selected to inspire teachers to reflect on and talk about their own experiences and beliefs.

Professional development providers might use an article to illustrate a concept, providing time for reading and discussion. Teachers might want to share the journal with their colleagues, discussing their responses to the stories, perhaps even collaborating to try a new approach. Administrators might distribute copies to staff members, inviting them to share their reactions and reflections at a meeting or by e-mail exchanges. *Northwest Teacher* can serve as a starting point for group dialogue about issues in mathematics and science teaching, as well as for independent reading and personal reflection.

STANDARDS AND THE IMPULSE for Human Betterment

STORY BY Denise Jarrett Weeks ILLUSTRATIONS BY students of Innerscape Art Center

BUFFETED BY THE REFORM whirlwind, teachers just want to know where they stand. Do they toe the standards line? Or rely on their inner authority and professional knowledge? Some say: You can do both.

PORTLAND, OREGON—Alfie Kohn shifts in the passenger seat of his host's little red sedan and objects to the prevailing notion about why America needs tougher education standards. He's hitching a ride to yet another airport in his lecture tour, and he's tired. At the banquet hall he's just left, people are still talking about his spirited speech on the ills of standardization and high-stakes testing. Some 1,100 teachers, administrators, and policymakers are there, attending the Education Now and in the Future conference hosted by the Northwest Regional Educational Laboratory, and the collective blood pressure in the hall is up. Love him or hate him, Alfie Kohn knows how to energize a conversation.

With residual vim, Kohn now trounces the axiom that tougher standards and accountability are needed to prepare students to succeed in the 21st century.

"It's typically politicians and businesspeople who are using that slogan to justify an agenda that is often out of step with the best theory, research, and practice," says Kohn, a former teacher. "I'd say that the 21st century is a time of tremendous change where we can't even predict what people will need to know in 10 years. It's a strong argument for teaching kids more *how* to think than *what* to think."

future fulfillment

Mathematics and science are often at the center of talk about the knowledge and skills needed for the 21st century. For some, the issue is less about whether mathematics and science skills are essential for success in the technological age, and more about what kinds of mathematics and science knowledge are important for their own sake. The best standards documents, they say, promote deep learning about the nature of mathematics—"understanding ideas from the inside out," says Kohn—over rote learning of facts and algorithms solely for practical application. And they don't edge out other important parts of school, like art and PE. Focusing too far in the future to a youngster's employability means overlooking the flesh-and-blood needs of the child, today.

"I do not wish to sacrifice my child on the altar of the future. Talk to me about today," a parent writes in *Educational Leadership* (Zukas, 2000).

Kohn's message is in demand. His books, *The Schools Our Children Deserve* and *The Case Against Standardized Testing*, are widely cited and his speaking engagements keep him traveling year round. Yet, the distinctions he and others make among different kinds of standards are not always heard. The crucial distinction, they say, is between standards that are broadly conceived guidelines and those that are prescriptive mandates that narrowly specify particular facts and skills.

Each approach has its defenders. However, say Gerald Grant and Christine Murray (1999) in *Teaching in America: The Slow Revolution*, "The ultimate test of any educational reform ... must be whether it enhances or obstructs the essential acts of teaching, and thereby fires the imagination, deepens the competence, and touches the hearts and minds of children."

So while this is being sorted out, where should teachers stand? Perhaps on their own professional authority, informed by a full understanding of what the standards reveal about teaching and learning and what they require of teachers and students.

The standards developed by professional organizations like the National Council of Teachers of Mathematics (NCTM, 2000b), the American Association for the Advancement of Science (AAAS,

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1990), and the National Research Council (NRC, 1996), are often described as overarching guidelines for teaching and learning that help teachers and students advance without stifling innovation with high-stakes consequences.

But many states, in an effort toward precision and accountability, have developed detailed standards that spell out what is to be taught and when. They come with high-stakes tests to be used to determine whether a student advances to the next grade or graduates from high school. Increasingly, these tests are being considered for use in making judgments about teachers' performance and the viability of schools.

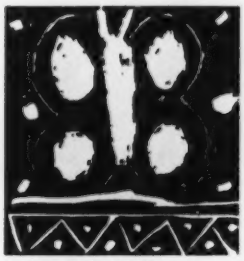
Indeed, strong accountability is a central intent of the new administration. Just days after coming to office, President George W. Bush issued his agenda for education reform, "No Child Left Behind," promising to "reward success and sanction failure" in the education system. His agenda proposes annual state reading and mathematics assessments in grades three through eight with strong sanctions for schools if students don't measure up. Moreover, states could increase their federal funding by creating assessment systems to measure teachers' performance by students' achievement.

In *Education in a New Era*, Ronald Brandt and David Perkins (2000) write, "In today's political climate, educators are under great pressure to somehow bring all children to high standards of performance. In the years ahead, the pressure is sure to grow even more intense."

room to improve

Let's consider what's sustaining the movement for higher standards and accountability. Government and corporate interests, for sure, contribute significantly to the initiatives, policies, and funding that drive the mechanism of reform. But it's hard to overlook the likeliest forces for change: students' underachievement, especially in mathematics, science, and literacy; dropout rates among minority and poor students that have gone unchecked for years; and throngs of first-year college students who need remedial study before they're prepared to do college-level work.

International studies indicate that, compared to their peers in other countries, U.S. students underachieve in mathematics and science, especially in secondary



By Julia Radinsky, 8

grades (National Center for Education Statistics, 1996, 1997; Gonzales, et al., 2000). Half of high school students in the largest U.S. cities are dropping out (Balfanz & Legters, 2001), and in the Northwest, about a third of all high school students fail to graduate (Barnett & Greenough, 2000). Among those who do graduate and go on to college, many find themselves not up to the task of college-level coursework. More than a third of this year's first-year college students received or planned to get remedial help in mathematics ("This year's ...," 2001).

Young people, it seems, do need better preparation to pursue a life well-lived in a more complex and technological world. Information, conveyed by technology, is today's economic and social currency, and this calls on knowledge and skills that are different from those that could buy a person, in the last century, a ticket to the middle class. But beyond that, mathematics and science are essential to the personal store of knowledge everyone should be able to draw upon (AAAS, 1990). Sharing in humankind's understanding about the way the world works is personally rewarding and makes informed decision-making and active citizenship possible.

"There is a movement in all areas of human production to activities based on a much higher level of knowledge, information, and communication," writes education scholar Uri Merry in *Coping With Uncertainty* (1995), "[T]he new system for wealth creation more and more depends on the exchange of data, information, and knowledge ... if knowledge is not exchanged, wealth is not created."

The question, he says, is if the power shift to a knowledge base is the privilege of a few or the natural right of all. The nation's growing ethnic diversity presses the case that schools need to educate all students to higher standards.

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talking values

James Hiebert, author and researcher, says that standards are statements about what we most value. If human advancement is what we value most, we must make judgments about what's good, what's bad, what works, what doesn't. And, says Hiebert, "the evidence indicates that the traditional curriculum and instructional methods in the United States are not serving our students well" (1999).

Value judgments are necessary to decisionmaking, said the late Kenneth E. Boulding, a social scientist who wrote widely about economics, international peace, and the future of humankind. And decisions are essentially a choice between different images of the future. In his 1985 book, *Human Betterment*, Boulding wrote that human improvement is achieved by envisioning a desired future, setting standards, and testing our progress.

"Hope for the future must come out of creative fantasy, the imagining of futures that imply human betterment, which can be tested ... and which can inspire action and behavior," he wrote. Boulding believed this to be our moral responsibility, even when certainty is impossible.

By Carina French, 10

The standards movement can be seen as an attempt to step up to that responsibility, as a society, and to make the best choices possible to lay the groundwork for a future in which society's benefits can be claimed by all. Says Hiebert, "We make decisions with levels of confidence, not with certainty."

It is with a mix of opinions that we lay the surest road to improvement, says Boulding. Since standards can embody different value systems, each of which may be justified by an appeal to human betterment, the standards movement is paved with disagreement.

debating 'the test'

These days, the standards debate is hottest around the issue of testing. In his midcourse review of the standards movement last year, former Education Secretary Richard W. Riley advised states not to rely on a single test to measure students' knowledge of the standards (Sack, 2000). Professional organizations, such as the NCTM (2000a), the National Education Association (2000), and the American Educational Research Association (2000), fired off position statements opposing high-stakes testing. "Decisions that affect individual students' life chances or educational opportunities should not be made on the basis of test scores alone," stated the AERA.

Parents overwhelmingly agree, according to a survey by Public Agenda (2000) in which 78 percent of parents say that "it's wrong to use the results of just one test to decide whether a student gets promoted or graduates."

Robert Marzano, a senior fellow at the McREL Institute in Aurora, Colorado, says that the use of a test as the primary way of implementing standards is commonly the first, and sometimes the only, approach considered by state departments of education.

"However, state-level standards tests have come under some harsh criticism of late," say Marzano and John Kendall (1998). Many state tests are not based on their own standards, meaning important areas of their standards don't get assessed. Such tests fail to provide an adequate range of methods for students to demonstrate their learning, and states are often weak in interpreting and using assessment results.

In the Northwest, Alaska, Idaho, Montana, Oregon, and Washington have adopted standards for student performance. All of them have statewide standardized testing in place, or soon will, and in Alaska and Idaho, students will be required to pass an exit exam before they can receive a high school diploma. However, assessments and instruction still need to be aligned with standards (Barnett & Greenough, 2000).

Nevertheless, Marzano and Kendall say that it "behooves" the classroom teacher to know the content covered in state tests and to make sure that it is covered as a normal part of classroom work. While many are wary of "teaching to the test"—and neglecting important content that isn't on it—Marzano and Kendall say it's only fair that students know the criteria on which they

are being judged, particularly if the judgments are to have high-stakes implications.

autonomy and accountability

The same might be said for teachers who are being judged by students' performance on state tests, says Washington science teacher Jim Boyce, who teaches at White River High School in Buckley.

"I don't want some kind of vague threat that I'm going to be evaluated on something I'm not clear about," he says. "If somebody's going to tell me, 'Okay, this is what you need to do,' then make it really specific, and give me some cool lesson plans, even, to do it."

But it can feel like a Catch-22. Many teachers value their professional autonomy to design curriculum and choose the right teaching approach for their particular students. Yet, if their professional advancement is going to be based on how well their students score on a standardized test, teachers will often want the terms of the standards and assessment systems to be explicit.

"The strength of the American educational system is the fact that there is a lot of room for creativity," says Boyce. "If people aren't allowed to teach to their strengths, but instead to some test, you're going to get an uninspired product."

For Mike Tomlinson, a fourth-grade teacher at Durham Elementary in Tigard, Oregon, state standards and assessments are like lighthouses, concrete guides to common goals.

"I just see standards as a better definition of what we're supposed to be teaching. The standards give you some concrete direction on which to base progress and instruction," he says. "I can pick and choose the actual content or the teaching strategies that I use in the classroom." He relies on national standards documents, like *Benchmarks for Science Literacy* (AAAS, 1993) and *National Science Education Standards* (NRC, 1996), to help him understand and apply his state's standards.

Courtesy Innerscape Art Center

Because reform policy is still evolving, it may take some fortitude to sort through incomplete or mixed messages still coming from states and districts about standards and testing, say Marzano and Kendall. But they note, "In our opinion, one of the biggest mistakes a teacher can make is to ignore the standards movement."

a delicate dance

While teachers might feel that they must "live or die" by the standards, it might also be said that the standards movement will succeed or fail at the classroom level. The reciprocal relationship between standards and teaching is complex.

"Teachers are still fundamental, absolutely fundamental to any kind of lasting change," says Leslie Gordon, a former elementary teacher in Fairbanks, Alaska, who is principal investigator for two National Science Foundation projects that support standards-based teaching.

Alfie Kohn also stresses the central importance of teachers. Their openness to change, he says, depends on the kinds of standards they are being asked to address. "A friend of mine likes to say that people don't resist change, they resist being changed. Standards that are useful guidelines for richer learning will make it through that screen. Standards that are top-down mandates will be opposed, and for good reason."

On that point Gordon is optimistic. Standards can be powerful allies to teaching, she says, especially when they are unfettered by high-stakes consequences. "I feel strongly that standards can support teacher autonomy and do function well in an inquiry-based learning environment. Standards provide benchmarks so that students are not short-changed, but there is considerable room to negotiate teacher and student goals within the framework they provide."

Denise Jarrett Weeks is coeditor of Northwest Teacher. ●

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Teachers

TAKING CHARGE OF CHANGE

STORY AND PHOTOS BY Suzie Boss

EDMONDS, WASHINGTON—A day before the presidential election, first-grade teacher Beth Black wasn't talking about politics. But she might well have been, when she suggested that parents "find a way to connect math to the day; get mathematics into our culture. We know that parents read to their kids before bed. But what if they told them a math story, too? How rich that could be!" By the next evening, the whole world was watching America puzzle over a story problem from the real world: If it takes 270 electoral votes to become president, how many more votes does each candidate need?

In Edmonds, students and teachers manage to get mathematics into the culture every day, and in a wide variety of ways. "It's our passion," says fourth-grade teacher Cheri Schuricht, one of a cadre of teacher-leaders who spent five years under a National Science Foundation grant transforming the way math is taught in the district. Now, Edmonds teachers are going a step further, helping to define what Washington's Essential Academic Learning Requirements—the state's standards—will look like in the day-to-day culture of their classrooms. Far from being separate tasks, the two initiatives overlap and interweave, building a stronger foundation for student learning.

When they gather to talk about standards—which they do everywhere from building-level Math Leadership Teams to an informal quilting group—these Edmonds teachers don't vent about top-down mandates. Instead, they talk with energy and enthusiasm about how standards are helping them do a more effective job. "If we sound more evolved in our thinking," Schuricht suggests, "it's only because we've already put so much time and energy into these discussions. We've sat for hours around each other's dining room tables," talking about ways to teach so that students develop deep, lasting understanding of mathematical concepts. And that, in a nutshell, is what standards promise to deliver.

For primary teacher Patti Boyle, "teaching to make sense" means exploring her students' math strategies.

TOGETHER, A CADRE OF TEACHERS HAS CARRIED REFORM TO THE "TIPPING POINT," TOUCHING OFF A CHANGE IN MATH INSTRUCTION IN CLASSROOMS THROUGHOUT THEIR DISTRICT

what standards mean

Edmonds School District offers a look at what can happen when a whole learning community embraces standards. Says Black, "There's something called the 'tipping point,' where an idea becomes so widespread that it tips and becomes part of the general culture. That's happened here. It's no longer OK to do things your old way."

Back in the days before standards, recalls longtime primary teacher Patti Boyle, "most teachers had an intuitive sense of what their students needed to know. But the problem was, the teacher next door might have had a different intuitive understanding." The only standard back then, she says, "was the textbook. That's what told teachers what they needed to teach."

"There's a lot of material a teacher could cover," acknowledges Sally Harrison, Executive Director for Teaching and Learning for the Edmonds district. "Standards put boundaries around the most critical work for students to do within the big picture of math, to help us settle into what we'll focus on teaching."

Black has come to see standards "like binoculars. They help us look closely at what we want to see." Binoculars, of course, are just the kind of tool you'd want to pack along on a journey. In Edmonds, teachers' lengthy discussions about standards have caused them to see themselves and their students as fellow travelers—moving toward the future. "The journey of our kids is from elementary school to middle school to high school, and beyond," explains Harrison. "Standards help us be sure they'll have the knowledge and skills they need at each step along the way. And standards also help teachers see: this is my part in that journey."

The 21,000-student Edmonds district is geographically large, encompassing several suburban neighborhoods north of Seattle. But local control remains strong, with 24 elementary schools governed by site-based decisionmaking councils. Configurations include team teaching, multiage classrooms, teachers who "loop" with their students from one grade to the next, and a few K–8 elementary schools.

Such variation means there's room for all kinds of teaching styles. Standards ensure that, regardless of style, substance is consistent throughout the district. "Standards aren't prescriptive—they don't tell us how we have to get there," Harrison says. "What they tell us is that any kid at any school should be able to make progress toward the same goals."

What's more, standards have ensured that teachers, parents, administrators, and students are all speaking the same language. "With standards," Black explains, "parents have a good idea what their children need to learn. Teachers have the same idea. And so do kids. We all have the same goal." To make standards more succinct and easier to understand at a glance, Edmonds staffers have boiled them down to a one-page list of "must learns" for each grade.

At the start of first grade, Black conducts a quick assessment to size up each child's skills. Then she meets with each student and his or her parents. All parties—including the first-grader—agree on learning goals to tackle together during the coming school year. Black often suggests activities a child could do at home to build on classroom learning (such as those bedtime math stories). Having a clear idea of academic goals, she says, "is what is making us all work so hard. But it's also helping us work smarter."

classroom options

In Patti Boyle's multigrade primary class at Chase Lake Elementary School, "mental math" time begins with her students gathered in a circle, colorful plastic cubes and pudgy fingers at the ready. She writes an addition problem on the chalkboard (9 + 3 + 7 = ?), and challenges the class to solve it. "Remember," she adds, "you have tools and time."

In the animated discussion that follows, Boyle is listening for more than the right answer. She wants to know what these first- and second-graders are thinking as they work toward a solution. One girl says she "picked the biggest number and counted up," using the cubes. A boy knows that 3 + 7 add up to 10, so he starts with that sum and adds nine more, doing the calculations in his head. "And how do you know that 3 + 7 = 10?" Boyle asks. "I just know," he says with confidence.

Next, Boyle sends the class off to explore hands-on math stations. Although the stations vary, they all involve the same concept: measuring with nonstandard units. This may seem like a game to students, but Boyle's intent is serious: "teaching to make sense."

Boyle was also one of the teacher-leaders involved in the Edmonds Math Project, and that experience has permanently

A first-grader in Beth Black's class puzzles over a hands-on problem.

changed how she works with children. "We learned to ask our students, what do you want to know? How are you going to get there?" Those are quite different questions, she says, "from asking a teacher what material you need to cover. It's not a race to cover as much of the curriculum as possible. Instead we're asking: What do my students understand? How do I know they understand?" Posing those essential questions, she says, "has affected everything I do as a teacher."

Several miles east at Maplewood School, a K–8 parent cooperative, teacher Nanette Peppin is working with her third-grade students on the concept of multiplication. That doesn't mean just committing "times tables" to memory, she says. "We used to teach multiplication by having students memorize facts. Now, they have to be able to apply the concept and communicate their thinking. They need to know the why of math."

Peppin introduces the concept of prime numbers by asking, "Is 37 a multiple of any other number?" Students have made number charts to help them learn multiples, and they search their charts for "37." One girl has a brainstorm: "If we stack up all the number charts (on the overhead projector), then any numbers that aren't colored in are prime!" Sure enough, her system works.

All over the district, teachers put their own style on interactive, experiential lessons. But they are guided by a common philosophy about learning and a common continuum of academic goals. Explains Boyle, "You set up activities that create a need. If the goal for young children is counting and accuracy, that means they need to learn to count with big numbers and number combinations: what are all the combinations that add up to six, for instance?" The teacher's job, Boyle says, "is to ask the big questions, so we're sure our students know what they need to know."

Because all teachers are using the same continuum of academic goals—the mathematics standards—the learning process becomes seamless from grade to grade.

"In first grade," Black explains, "we can look ahead to what students will need to know by fourth grade." That's the first year students take a standardized test called the Washington Assessment of Student Learning, or WASL. "Unless we do certain things now," Black says, "we know they won't get to those fourth-grade goals."

Not that the district encourages teaching to the test, stresses Harrison. "What we want is a rich math curriculum that builds understanding," she says. Theoretically, deep understanding should naturally lead to respectable scores on a test that's been designed to align with standards.

But for a fourth-grade teacher like Schuricht, whose students will take the WASL in the spring, the pressure is undeniable. "I look at those students coming in the door in September and have to wonder whether, by test time in April, they'll know what they need to know," she admits. Her own confidence grows when she sees students "coming in with common experiences, using common vocabulary, knowing how to use similar strategies. That makes a huge difference. I know that other teachers before me have covered important concepts, because it's part of our standards. Our district becomes more of a community of educators working together, rather than teachers being off in their independent boxes, unaware of what each other is doing in the classroom."

ABOVE: Getting excited about math has become a daily event at Chase Lake Elementary.

LEFT: Maplewood third-grade teacher Nanette Peppin pushes her students to understand "the why of math."

11

assessing progress

Beth Black, with 23 years of experience in education, says the ongoing dialogue about standards causes even the most veteran teachers to consider important questions, like what should a child know and be able to do? How do we evaluate the evidence that indicates what the child can do? "The most interesting question to me right now," Black says, "is how good is good enough? How do you know when you've met the standard?"

As part of its move toward standards-based reform, the Edmonds district has revised its report cards. Instead of letter grades, the district now uses a numerical scale (from one to four) designed to track a student's progress toward meeting standards. Teachers played a big role in designing the new reporting system, and they're also instrumental in explaining the system to parents and students.

"It's important to begin with the end in mind," Schuricht says. "What will the evidence look like? What does a '3' look like? A '4'?" When parents see a student score of "2" or "3," for instance, "we need to be able to show them samples of student work. They can look at their own child's work, and they can look at a sample of work we consider a '4,' and they'll be able to see the difference." The numerical scoring system also conveys the idea of progress. Explains Boyle, "A score of '3' tells the student and the parents: You're meeting the standard, and there is evidence that you understand the concepts."

But numbers don't tell the whole story. "The most critical part of teaching," Black says, "is giving students feedback. You have to share with them: What's good about this? What could you do differently? Taking that time to reflect is so important, even if it means slowing down and doing fewer tasks. This is where the math is."

From the start of their journey, Edmonds teachers have kept their eyes on the big ideas. Early on, they embraced the lofty standards of the National Council of Teachers of Mathematics (NCTM). Many teachers found they had to relearn mathematics themselves, to become better teachers. Black recalls wanting to be a chemist when she was a teenager. "That was my dream. But I didn't have the math. So I could never take physics or chemistry." Not until years later, when she took a class called "Math for Phobics," did she grasp the big ideas of mathematics. Ever since, she's been a proponent of teaching methods that enable every student to cement understanding. "I don't want anyone denied a career choice because of math. We all have the minds for it."

This decadelong discussion about mathematics instruction isn't over in Edmonds, teachers agree. But there's widespread agreement that this is the right path to take. "Once you've taught this way," says Black, "you can never go back."

Suzie Boss is associate editor of Northwest Education.

Questions To Consider

- **What's our picture of mathematics education?** To reach consensus, Edmonds teachers undertook mathematics studies, watched videos of real-life teaching practices, and invested hours in talking about what helps children learn.
- **How can we help parents understand standards?** Districts using new teaching strategies to reach standards often must also educate parents. What experiences could be created to help parents see what learning mathematics "feels like" today?
- **How do we find the time?** Grant funding helped Edmonds teachers afford time for change to happen. How might your school or district create time for teachers to engage in thoughtful conversations?
- **How well do we nurture our teachers?** Edmonds staffers reformed mathematics teaching practices by creating safe environments where teachers felt free to ask difficult questions. How might your district do the same?
- **How important are test scores?** In standards-based teaching, conceptual understanding may precede mastery of basic skills. How comfortable will you be if your students score poorly on a standardized test of basic skills? How can you assure parents and others that the "dip" in scores is most likely temporary?

USING STANDARDS TO Illuminate Big Ideas in Science

STORY BY Jennifer Stepanek PHOTOS BY Marlo Blewett

WITH ONE TEACHER'S thoughtful and imaginative approach, standards help provide students with meaningful and engaging science learning.

BELGRADE, MONTANA—It is January, the beginning of a new quarter at Belgrade High School. The hectic dash of finals week is over, and the students in Marlo Blewett's biology class are beginning a new unit—they are making babies.

"The kids are thrilled when they first hear about this lab," Blewett says. "They can't wait to go home and tell their parents that they are making babies in biology. But I haven't had any phone calls from concerned parents yet," she adds, laughing.

The Beaker Babies activity is actually an introductory lab in a genetics unit. The "babies" that students create are really just models of the process of meiosis and reproduction. The students work in pairs, and they begin by creating a data table of their own personal traits, such as hair color, eye color, and tongue-rolling ability. Each student uses these traits to construct first a chromosome model and then a gamete, or sex cell, model. The partners then cross their gametes, filling in the table with the resulting traits of their baby and repeat the process to create a grandchild. The proud "parents" will then draw a picture of their baby to share with the rest of the class.

Marlo Blewett is a Montana native originally from the Great Falls area and this is her third year as a science teacher. She originally earned a degree in engineering and worked as a chemical engineer before going back to school to become a teacher. As a new teacher, Blewett has always made the science standards a part of her teaching.

Montana's approach to establishing standards is unique among the Northwest states. Rather than developing high-stakes assessments to drive the implementation of standards, the state has focused more on providing professional development for teachers to help them begin using standards. Montana's strong tradition of independence and local control is apparent in this strategy. "I don't feel a lot of pressure to use the standards," Blewett says. "I use them because they have been a part of my training, but also because I see the standards as meaningful and valuable tools." Her approach reveals how the standards influence teachers' and students' work in multiple ways and illustrates the thoughtful and imaginative process that standards inspire.

crafting lessons

Perhaps the most powerful role that standards can fill is as a guideline for the curriculum. For example, in genetics the Montana science standards call for students to understand the structure of DNA and the molecular basis of heredity. "The standards help me to ensure that my students are getting the information that they will need," Blewett explains. "They have definitely made me more aware of what I should be doing as a science teacher."

"THE STANDARDS HELP ME TO ENSURE THAT MY STUDENTS ARE GETTING THE INFORMATION THAT THEY WILL NEED," **Blewett explains.** "THEY HAVE DEFINITELY MADE ME MORE AWARE OF WHAT I SHOULD BE DOING AS A SCIENCE TEACHER."

Blewett finds that the standards are an effective tool for selecting specific areas from the textbook that she uses. "The standards help me to focus on the information that students really need, and it makes the content much more manageable." Rather than working her way through the textbook, she builds on the material that she selects by supplementing it with activities and other resources.

Selecting content is only the first step in Blewett's process for creating learning opportunities for her students. While standards provide a framework for the curriculum, they do not dictate methods that teachers will use. "The standards alone are just one piece of information that informs my teaching. No two teachers are going to be the same just because they are using the same standard," Blewett points out.

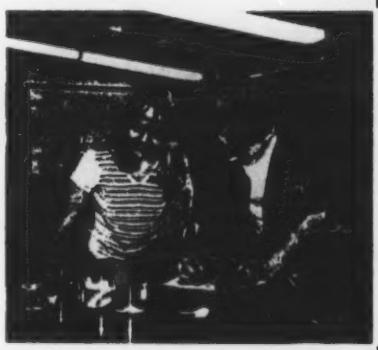
As she develops standards-based units and creates activities, Blewett says that her fellow teachers are often the first resource that she consults. "Teachers are really the best resource that I use. They are so open and willing to help. I don't think there are many other professions like that." Blewett often uses METNET, Montana's electronic bulletin board for teachers, when she has a question or is looking for ideas. "I can post a question on METNET and I usually get at least 15 responses by the next day."

Walt Woolbaugh, who teaches science at nearby Manhattan Middle School, is Blewett's mentor teacher. She says that he is a constant source for ideas and support. "When I'm developing a new unit, we usually get together and talk about it." In fact, Woolbaugh provided Blewett with the basis for the Beaker Babies lab. She adapted it and added to it so that it was appropriate for her students. She says that this is a key step, because activities that are labeled standards-based or look good at first may not be suitable. "When I find an activity that seems appropriate and that I like, I analyze it more closely to make sure that it actually fits the standards."

making connections

The science standards not only outline the content that students study, but also define high expectations for students. "There's a reason for the standards—students need to have a certain level of understanding of science for the future. They will need it to pursue their goals for education and careers, and for their general knowledge of the world," Blewett explains. Helping students to develop thinking and reasoning abilities in science involves much more that just exposing them to a standards-based curriculum. Teachers are challenged to ensure that students connect with the content and that they understand the concepts and processes they are learning.

Today's lab provides a meaningful context for Blewett's students to learn about genetics. "One of the reasons I chose this activity is that it gets the students interested," she explains. "The scenario does grab their attention, but that isn't enough. It really connects students to the topic, because they are looking at their own traits and their families, and they can explore why they have the traits that they have."



ABOVE: Two students create a chromosome model.

LEFT: The lab provides a fun and meaningful context for important genetics concepts.

BOTTOM: As students create their models, they gain hands-on experience of the process of genetics.

The lab also gives the students hands-on experience of how the process of genetics works. As they study genetics, students tackle a great deal of unfamiliar terminology. Instead of just memorizing the definitions of terms like "gamete" and "allele," Blewett's students are building an understanding of the whole process and how all the terms fit together. "Now they are talking about genotype and phenotype as if those words were a part of their everyday speech," she notes.

Blewett finds that rather than limiting her repertoire, the standards inspire her to be creative and flexible. "The standards have high expectations for all students. But students are different, and they learn in different ways. I have to make sure that the students experience important concepts in more than one way—I can't use only one approach.

"It's a challenge to achieve a balance," she continues. "Sometimes I give lectures, sometimes I use inquiry strategies. Using the standards is difficult, but it's also exciting. They really challenge me to be creative."

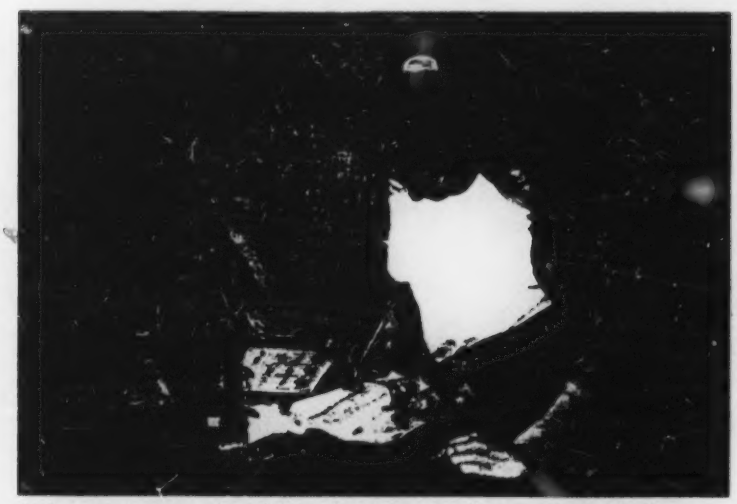
tracking progress

Blewett continues to draw on standards beyond the planning stages in her teaching, using them as tools to guide and evaluate instruction. This reinforces her confidence in her teaching. "Every teacher wants to know that they are providing quality. I try to keep going back to make sure that the standards are being taught," she says.

Reflection is an important part of her process, but finding time for it is Blewett's biggest challenge in using standards. "I am constantly changing the way I teach, but it is hard not to get stuck in a rut. It takes a lot of time to keep referring back to the standards—'Am I using the standards? Am I using them correctly? What do I need to improve?'" Like so many teachers, she finds that time for this kind of reflection is rare, with pressing demands like preparing labs and grading papers.

Blewett uses assessments to frequently monitor if students are meeting the standards, but she also asks her students to evaluate her class. "This was really difficult at first, because I had to deal with the bad and the good. But asking for the students' feedback is very informative. Assessments tell me whether or not the students 'get it.' The evaluations give me some ideas about why they get it, what was effective for them." Blewett uses the students' input to plan for future classes, beginning the cycle again.

> "USING THE STANDARDS IS DIFFICULT, **but it's also exciting.** THEY REALLY CHALLENGE ME TO BE CREATIVE."



Students generate data tables of their traits, which they will use to make their "babies."

As the lab comes to a close, the students share the drawings they have made of their "babies." They obviously had fun with this part of the activity, incorporating their own distinctive features into their drawings. One baby boy sports a backwards baseball cap, while a baby girl is pictured with a carefully styled hairdo.

While they enjoyed themselves, the students clearly developed a solid grounding in meiosis and are ready to learn more about genetics. Blewett says she is

pleased with this balance. "I don't always start out with a lab like I did today, but it worked very well. The students really had to think about their task. I saw a lot of thinking going on, and that is great. I just love it when that happens."

Jennifer Stepanek is coeditor of Northwest Teacher.

Questions To Consider

- **What do the standards mean?** In science, it is helpful to choose one standard at a time, looking at the corresponding sections in *Science for All Americans: Project 2061* and *Benchmarks for Science Literacy: Project 2061* published by the American Association for the Advancement of Science and the *National Science Education Standards* by the National Research Council. It may be helpful to talk with other teachers about their interpretations.
- **How will students demonstrate that they meet the standard?** It may be most effective to work backward from the standard and the level of performance indicated for students. Think about what types of evidence will be the most meaningful and appropriate.
- **What activities will enable my students to develop understanding of the concept?** The activities should build students' interests and address their different learning needs. Also consider what instructional strategies will facilitate students' understanding.
- **Will this activity alone address the standard or will other activities be needed?** After an activity is created or selected, these questions will help ensure that a unit of instruction is truly standards based. They can also be used after students have completed an activity to evaluate its effectiveness.

SCOPE

CONTINUED FROM PAGE 5

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TECHNOLOGY AND STANDARDS:
connecting to curriculum

THE INTERNET CAN YIELD RICH RESOURCES for professional growth. At the Web sites featured here, teachers can explore examples of standards-based classroom projects to see how others have created powerful learning around standards.

In Oregon, a regional consortium funded by the Eisenhower Professional Development Fund for Higher Education, the Oregon Education Association, and the Oregon US West/NEA Teacher Network prepared resource modules to help teachers use standards as a basis for curriculum planning, and to help students meet state content standards. The classroom-tested modules, contributed by a technology leadership cadre of classroom teachers, demonstrate how technology can be used to improve teaching and learning in core academic areas.

Sam Miller is a middle school science teacher in Eugene, Oregon, and a member of the technology leadership cadre. He contributed a module entitled "The End of the Earth" (otn.uoregon.edu/eisenhower/leadership/model_3/index.html), designed to help his eighth-grade students meet four of Oregon's science content standards. He candidly shares his thoughts, considering issues such as changing instructional strategies, collegial expectations, and assessment practices. He provides sample lesson plans with a complete list of the technology resources he used to address specific standards.

"I highlighted the benchmarks for grade eight science and determined which ones my colleagues expected me to address," Miller writes. "These expectations were established during curriculum meetings at my school. Using the list of benchmarks, I contemplated which areas of my curriculum were strong, weak, or nonexistent in terms of the benchmarks. From this information, I identified areas that could be grouped into common units of instruction."

Peter Knowles, a teacher at Columbia High School in White Salmon, Washington, developed a cross-disciplinary social studies unit called "The Global Challenge" that is featured online at the Web site of NWREL's Northwest Educational Technology Consortium (www.netc.org/classrooms@work/classrooms/peter/index.html). This standards-based unit presents student teams with an authentic research and analysis task that requires them to collect, organize, and analyze data, and display their data in tables, charts, and graphs using spreadsheet software. In manipulating raw data and explaining their findings, students use math to define and solve problems, developing an understanding of how math ideas connect to real-life situations.

"One thing the standards have done is get me to think about what I'm actually doing in my classroom —on a coursewide basis and a unitwide basis, and even on a daily basis," says Knowles. "I ask myself, 'Is this really what I need to be doing?' They have been helpful with seeing when I haven't addressed something. They give you a framework, a target to work for and there is plenty of freedom to get there."

For Theresa Maves' teaching team at O'Leary Junior High in Twin Falls, Idaho, the "what" comes first. To plan curriculum, they use the frameworks established by the district curriculum and state standards, aligning the concepts between their content areas of math, science, and language arts. Then, they plan for the "how" by designing powerful learning through interdisciplinary projects. This team developed a project that is also featured at the NETC Web site (www.netc.org/classrooms@work/classrooms/middleteam). "It's a Wild Ride" uses the design of roller coasters to help students meet standards in multiple subject areas. At the site, the teachers explain their method of integrating Idaho's content standards into an interdisciplinary curriculum.

"In this district we do have a curriculum, and we do have the standards, but how we do it is totally up to us," says Maves. "Our chosen method is integrated instruction. We look for connections within those content areas that we are required to teach."

AMY PEARL
is an instructional design associate for NWREL's Technology in Education Center.

books and materials available from THE LENDING RESOURCE COLLECTION

THE NWREL MATHEMATICS AND SCIENCE EDUCATION CENTER'S RESOURCE COLLECTION is a lending library of teacher-support material. Search the collection and request items from the Web site www.nwrel.org/msec/collect.html or call Amy Coyle at (503) 275-0457.

Excellent books and Web resources exist to help educators identify curricula that are aligned with district, state, and national standards.

tools for selecting and implementing standards-based curricula

Choosing a Standards-Based Mathematics Curriculum
Lynn T. Goldsmith, June Mark, & Ilene Kantrov (1998)
All districts at any stage of a mathematics adoption should read this book! Chapters include creating a professional development plan and developing community support.

Selecting Instructional Materials: A Guide for K–12 Science
Maxine Singer & Jan Tuomi (1999)
A recent publication that can help educators identify curricula that are aligned with the National Science Education Standards.

A Guide to Selecting & Purchasing Science Instructional Materials
While developed for California educators, this guide has many tools and hints. Available online: www.k12alliance.net/publications.html

Identifying Curriculum Materials for Science Literacy: A Project 2061 Evaluation Tool
This resource explains the criteria and process used by the American Association for the Advancement of Science Project 2061 in its review of science texts. Available online: www.project2061.org/newsinfo/research/roseman/roseman2.html

reviews of standards-based curricula

Most programs claim to be "aligned with national standards," yet the instructional approaches and content vary widely. Several national organizations and panels have rated mathematics and science programs using specified criteria. It is important to examine the criteria used as well as the findings, both to identify the source of the ratings and to help determine how closely the criteria reflect the goals and standards promoted in your district.

U.S. Department of Education Expert Panel on Exemplary and Promising Mathematics Programs
In its evaluation, the Expert Panel examined each program's evidence of effectiveness, the quality of the curricula, and the level of teacher support. All programs are described online, along with the criteria used: www.enc.org/professional/federalresources/exemplary/

U.S. Department of Education Expert Panel on Exemplary and Promising Science Programs
Using criteria similar to the mathematics panel, the Expert Panel on science recently issued its findings: www.ed.gov/offices/OERI/ORAD/KAD/expert_panel/newscience_progs.html

AAAS Textbook Evaluations
In each of these documents, reviewers took samplings of certain content (middle grades mathematics and science, algebra, and high school biology) and applied rigorous criteria. These reviews are available online at: www.project2061.org/newsinfo/research/textbook/default.htm

The American Institute of Biological Sciences (AIBS) Review of Textbooks
This 2001 review examines 10 textbooks and instructional packages used in yearlong courses in the biological sciences in U.S. secondary schools. Available at at www.aibs.org

Review of Middle School Physical Science Texts
An analysis by the Physical Sciences Resource Center that addresses the accuracy, appropriateness, pedagogic effectiveness, and readability of textbooks. Available at: www.psrc-online.org

national centers

The EDC K–12 Mathematics Curriculum Center and the EDC K–12 Science Curriculum Dissemination Center help schools learn about NSF-funded curriculum. The Centers offer seminars, online tools, and other resources.
Mathematics: www.edc.org/mcc
Science: www.edc.org/cse/

AMY SUTTON
is a math and science resource specialist for NWREL.

LET US HEAR from you

Listening to one's 'inner voice of authority'

I am so glad to have received your first journal on math and science. It is the most comprehensive and concise explanation of the kinds of thoughts that have driven my teaching over the past 26 years.

Like many of the teachers whose stories are included, I have felt isolated and alone with no one or no place to share the issues, the struggles, the questions, the tried and discarded strategies with. It has been difficult to "develop my own inner voice of authority" with stronger criticism from recent outside pressures, but develop one I have, ironically, because I had been left to my own devices.

Thanks again for putting the journal together. Please keep me on your mailing list for future issues.

SHEILA KOYAMA
is a teacher in Edgewood, Washington.

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Alexis Mutchler, 7, a student at Innerscape Art Center in Portland, paints her self-portrait.

A WORD FROM THE DIRECTOR

KIT PEIXOTTO
peixottk@nwrel.org

NWREL'S MATHEMATICS and Science Education Center's new project emphasizes collaboration and sharing across the region to enhance K–12 mathematics and science education for all.

I am very pleased to let you know that in October 2000 NWREL's Mathematics and Science Education Center began a new scope of work as the Northwest Eisenhower Regional Consortium for Mathematics and Science. Serving the five-state region of Alaska, Idaho, Montana, Oregon, and Washington, the Consortium will conduct a variety of activities designed to help schools ensure that all students have opportunities to learn rigorous mathematics and science. In our new work we join the nine other Eisenhower Regional Consortia and the Eisenhower National Clearinghouse in working to provide professional development, networking, and information services on important issues in mathematics and science education.

Our work is driven by the needs of the schools in our region. In order to meet these needs and to fulfill the charge from the U.S. Department of Education and Congress, we will strive to provide educators with:

- Access to best practices, particularly for diverse learners
- Assistance to overcome isolation and lack of resources in rural areas
- Services to support all students' efforts to meet state content and performance standards

Our most intensive work will take place at two partner sites in each state, where our staff will provide indepth technical assistance. The sites will be located in a school or district, and the majority of the sites will be located in rural areas. The focus and type of work will vary depending on local needs, but all sites will engage in activities that support teachers as inquirers and constructors of knowledge.

By Eva Garcia, Woodlawn Elementary, Portland, Oregon. Courtesy of Pacific Northwest College of Art, Young Artists' Program.

Our long-term goal is to build local capacity and establish collaborative relationships that will sustain these efforts over time. We believe that our work with the partner sites will also provide professional knowledge and models that other districts and schools can adapt and develop.

In fact, collaboration and sharing throughout the region are both the means and the desired outcome of our work. The Northwest Eisenhower Regional Consortium will attempt to maximize the impact of our activities by sharing effective resources, strategies, and materials with exemplary projects and organizations in the region. In some cases, these strategic alliances will provide learning opportunities for teacher leaders and professional development providers. In partnership with the departments of education in each state, the Consortium will cosponsor annual summer institutes for teachers.

Northwest Teacher is another important aspect of the Consortium's services. We will publish the journal three times a year, using it both as a professional development tool and as a method of sharing our work with a broad audience. Additional strategies for sharing information and resources are our Web site (www.nwrel.org/msec/nwerc) and a semi-monthly e-mail newsletter tailored for teachers in each state.

The title of this journal reflects our approach to improving mathematics and science education—teachers are the ones who make it happen. As we see it, the Consortium's task encompasses both direct services for teachers and advocacy for the support that teachers need. We are very excited as we begin our new endeavor, and we hope that you will share your thoughts, ideas, and feedback with us. ●

NORTHWEST
TEACHER
A Math and Science Journal
Devoted to Rigorous
and Imaginative Learning

NORTHWEST TEACHER IS PUBLISHED BY THE NORTHWEST EISENHOWER REGIONAL CONSORTIUM AT THE NORTHWEST REGIONAL EDUCATIONAL LABORATORY'S MATHEMATICS AND SCIENCE EDUCATION CENTER,
101 SW MAIN STREET, SUITE 500, PORTLAND, OREGON 97204
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